A Research Framework for Business Sustainability using Information Exchange – A Firm Centric Perspective

Completed Research Paper

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Abstract

The information systems research literature associated with sustainability has focused, by and large, on the ecological effects of computer manufacturing, components, toxicity of materials, energy usage in the manufacturing of computers, energy usage by deployed computers, and safe disposal of old machines. There has been scant or no attention paid to the effective use of information by firms for making the firm sustainable while also paying attention to the triple bottom line (3BL). In this paper, we identify the research gaps, which when filled can influence and affect information deployment practices in business settings, to proactively assist firms in becoming sustainable and competitive within their business environments, while meeting their 3BL goals. We recognize the need for an entity or enterprise, designated the Information Enterprise (IE) that is the repository and sole distributor of relevant information that participant firms will need for achieving sustainability without sacrificing their 3BL goals.

Keywords

Business Sustainability, Triple Bottom line, Information Exchange, Data Repository

Introduction

The focus of most, if not all, research efforts in sustainability have been centered on society, the ecology, and to a minimal extent on business profits – be it Green Chemistry, Green Engineering, or Green Environment. These research efforts, as also the practices espoused for adoption by businesses, have been heavily focused on reduction of resource consumption, reuse, recycling, and reduction or elimination of waste products. It is in this context that the research focus has been heavily inclined towards - green information. Green Computing (Green Information) in the research and popular literature has been synonymous with, exclusively, the efficient development of hardware components using ecologically safer materials, reduction in energy usage, avoidance of vampiring, and ecologically safe disposal of old computers, cell phones, wireless devices, and other computer components. In this view the role of the computer in sustainability is limited to how it is manufactured, how much of ecologically sensitive resources it uses, and how the components are disposed of and recycled after its end of life. Little or no attention has been paid to the role of information, per se, in making the activities of businesses more planet friendly, while at the same time promoting the sustainability of a business and its operations – from the product or service conception stage through its production, to its eventual deployment and recycling, in the case of material products. To use information in this fashion, we postulate that firm specific information availability in addition to availability of information that can affect production and deployment practices of the participants in an industry, normally not available to any single firm, would be needed. This suggests

the need for an entity or enterprise which is the repository of potentially useful information for businesses. This is a similar concept to the one that has been mandated by the US government for health care, by requiring the establishment of health information exchanges for ensuring the portability of electronic medical records. It is also along the lines of supply chain information sharing efforts in the automotive industry through the launch of Covisint. However, main objective of Covisint is to speed up decision making, eliminate waste and reduce cost throughout supply chain using information exchange. What we are suggesting goes beyond the limited purviews of the health information exchange mandate and the Covisint initiative. We are advocating for the acquisition and maintenance of information related to a business environment that can affect the sustainability and competitiveness of individual business organizations, in that environment, which choose to benefit from that information in reshaping their strategies and practices, with a view to sustainability of the firm while paying attention to the triple bottom line (3BL). Also, the mere presence of the information enterprise or information exchange (IE), and the availability of information from it, is no guarantee for sustainability of the firms in that business environment. These, participant firms must be appropriately prepared and positioned to be capable of contributing to the IE repository, as also be capable of effectively deploying and using the information from that repository to achieve sustainability while meeting the 3BL goals for their own organizations.

The rest of the paper is organized as follows. First, we review the literature extensively to identify the dominant themes in Green IS research. Next, we survey the literature on sustainability related to IS. This is followed by a survey of literature on the association of information systems with sustainable supply chains. These lead us to the identification of the gaps in the literature and the enumeration of the issues affecting sustainability of firms, not addressed in the literature on sustainability related to IS. Based on this, we advocate for the establishment of an information exchange entity with a focus on sustainability of firms. This is followed by a detailing of the issues that attend the establishment and operation of the information exchange mechanism, and the issues related to the deployment of this information by firms participating in this information exchange exercise. Finally, we outline a framework for research by categorizing the investigations needed in a variety of information deployment areas, and suggest methodologies and priorities for research.

Literature Review

Green IS

Watson et al. (2010) defines Green IS as "an integrated and cooperating set of people, processes, software, and information technologies to support individual, organizational, or societal goals (p.24)." We use Green IS instead of Green IT that can be found in other literature because our focus is beyond just the technology but also includes policies and procedures surrounding the organizations IS strategy. Another term found in Green IS literature is the triple bottom line (3BL) (Dyllick and Hockerts 2002; Kleindorfer et al. 2009; Watson et al. 2010). 3BL focuses the firm not only on profit but includes people and the planet as well. These goals can be met through eco-efficiency, eco-equity, and eco-effectiveness (Watson et al. 2010). Eco-efficiency focuses on the reduction of waste and energy use within the organization. This goal mostly corresponds with the profit side of the 3BL as efficiency also boosts profit. The eco-equity goal focuses on the preservation of resources for future generations. This goal has implications with the other two sides of 3BL: people and planet. The final goal, eco-effectiveness (Braungart et al. 2007; McDonough and Braungart 2002) focuses on the selection of resources an organization uses. Instead of achieving greater efficiencies, the firm should be looking at exploiting the correct resources. For example, instead of using less energy provided by fossil fuels, the firm should be using energy from renewable energy sources. This final goal focuses mostly on the planet side of 3BL.

In addition to these goals, a firm should also be aware of some of the key stakeholders for Green IS: suppliers, consumers, and government (Watson et al. 2010). In addition to achieving Green IS goals within the firm, it should also be aware of the ecological sustainability of its suppliers. These are the organizations that either provide energy or provide services that use energy such as cloud computing. Firms should also be aware of the impact of Green IS on their consumers. These are the stakeholders that will bear the final costs for any initiative that the firm will undertake. Finally, the firm should also be aware of the impact of government regulation and enforcement on any decision that the make with regards to Green IS. Will these regulations increase costs or time to a project under consideration and what steps does the firm have to

take to be in compliance? All three of these stakeholders need to be considered when executives make Green IS decisions.

Ecological Sustainability or Green IS has been examined in IT literature in various ways. The first group of literature focuses on the use of IT and its business transformation on the firms with regards to Green IS. Melville (2010) adapted the Belief-Action-Outcome theory to create a framework for Green IS. He argues that IS has a role in shaping beliefs within an organization which could lead to organizational transformations in environmental policies. Elliot (2011) took a more holistic approach to examining IT in the organization. He developed a model for studying IS where he argues that technology has an impact on both the beliefs of people and the monitoring and evaluation of the organization and these in turn can impact the quality of the environment. Ahmed and Sundaram (2012) used design science to create a roadmap for organizations to transform their practices to be more ecologically sustainable. They argue that through the use of IT, they can monitor their organization's progression, organizations can evaluate their practices and adjust those same practices to become more ecologically sustainable. Seidel et al. (2013) used a single case study to examine the effect of information systems on green organizations. Through the lens of functional affordance, they found that IS enables the organization to understand the impact of their practices and help evaluate future actions. These studies only focus on the role of IS on the firm's transformation to Green IS but do not help us understand how IS affects decision making within the organization, particularly in the context of business sustainability.

The second set of literature has a more varied focus. Butler (2011) examined the role of Green IS in manufacturing using the case study methodology. Through the use of institutional theory, he found that information systems can help share information so the decision makers can have a better view of the regulatory compliance of the organization. Using design science methodology, MacHaris et al. (2012) created a tool to support decision makers in making ecologically sustainable decisions. Loock et al. (2013) also used design science to create a web portal to help inform consumers of their energy use and help promote more ecologically sustainable behavior through the use of goal setting. Finally, Petrini and Pozzebon (2009) examined Business Intelligence's (BI) role in promoting Green IS. Through the use of Grounded Theory, they found that BI can help support management in their decision making through the monitoring of the organization's ecological sustainability performance.

IS and Sustainable Supply Chains

This group of ecological sustainability articles focus on supply chain management and its effect on the firm. Seuring and Muller (2008) reviewed past articles that examined ecologically sustainable supply chains and developed a framework for future research. Dao et al. (2011) created a framework based on the Resource-based Value model to show how both information technology and the supply chain can be leveraged for both ecological sustainability and for sustaining a competitive advantage. Seuring (2013) reviewed articles that focused on mathematically modeling sustainable supply chains. He found that the social side of ecological sustainability was often ignored and only the ecological effects from the supply chain were examined. Meacham et al. (2013) surveyed 159 manufacturing managers and found that greater information sharing among the supply chain partners has a positive relationship with environmental performance. More recently, Bhattacharjee and Cruz (2015) used a mathematical model to focus on a closed loop supply chain within the consumer electronics industry. They found that firms with well-developed return policies have a greater impact on ecological sustainability through the use of refurbishing returned products. Most of these articles had little to no focus on the information systems or Green IS and mostly focused on the policies pertaining to the supply chain.

Li, Zeng, Chen, Ogunseitan, & Stevels (2015) outline two serious global problems arising due to fast clock speed of electronic gadgets. First, the supply of valuable metals, precious metals, and rare metals is hard pressed to meet the growing demand from electronics manufacturing. Second, the artisanal mining practices have contributed to environmental pollution from persistent organic pollutants and nonferrous metals in e-waste with proven adverse impacts on human health. This research reveals the opportunity to build policies to reduce the risks from accumulating e-waste and ineffective recycling, and suggesting solutions at the manufacturing level such as reduction in the use of toxic materials, and designing for easier disassembly and resource recovery. However, the authors do not talk about using e-system or IS to reduce e-waste.

Ghana is one of the most stable democracies in Africa with thriving industries and technology development while the Agbogbloshie Market in the country is considered as the world's largest e-waste dump site taking around 192,000 tons of e-waste a year. A study by Amankwah-Amoah (2016) of the Ghanaian experience reviews that these e-wastes sent from advanced economies to developing countries are largely detrimental. However, they argue that there are some positive externalities of e-waste in sectors such as the second-hand market, aftermarket and the repair industry. While this research tries to provide an optimistic view of reducing e-waste, it does not touch upon the alternative supply chain that could reduce the e-waste that come to the Ghanaian e-waste graveyard.

Silvestre (2015) tried to fill the above gap by exploring how supply chain sustainability can be implemented and managed in emerging economies with an in-depth case study of the supply chain associated with upstream oil and gas industry in Brazil. His research was about financial performance, including technological aspects, environmental performance, social performance, and barriers to sustainability performance, and identifies that the technological barrier prevents learning that facilitate integration, relationship management and collaboration.

Relationships investigated	**Literature**	**Research Gaps**
Green IS/Green IT affecting sustainability	Ahmed and Sundaram 2012; Elliot 2011; Melville 2010; Seidel et al. 2013; Watson et al. 2010	Lacks explanation how IS affects decision making within the organization, particularly in the context of business sustainability
Green IS/Green IT affecting manufacturing	Butler 2011; Loock et al. 2013; MacHaris et al. 2012; Petrini and Pozzebon 2009	Focuses more on environmental aspects rather than business sustainability.
IS affecting Triple Bottom Line (3BL)	Dyllick and Hockerts 2002; Kleindorfer et al. 2009	Focuses on people profits and plants, but more on planet side. Lacks moderating effect of IS.
IS affecting Eco-effectiveness	Braungart et al. 2007; McDonough and Braungart 2002	Lacks emphasis on making the organization profitable. Main focus stays around environment and social goals.
IS affecting Sustainable Supply Chains	Bhattacharjee and Cruz 2015; Dao et al. 2011; Meacham et al. 2013; Seuring and Muller 2008; Seuring 2013; Silvestre 2015	Lacks the focus of using e-system or IS to reduce e-waste and overly focused on the policies pertaining to the supply chain
IS affecting waste reduction	Amankwah-Amoah 2016; Li et al. 2015	Lacks the suggestion of alternative supply chain that could reduce the e-waste that come to the e-waste graveyard
IS affecting Industrial Eco-systems	Chen et al. 2008; Côté and Smolenaars 1997	Lacks the view of assisting organizations to be more sustainable in the sense of flourishing in their line of business

Table 1. Relationships under Investigation, Relevant Literature and Research Gap

Côté & Smolenaars (1997) outline three pillars for deployment of industrial eco systems. They are information management, economic instruments and regulation reforms. Of the three the most critical

pillar is the information management systems. Effective functioning of the industrial ecosystem will depend on flow of materials within the supply chain and the community it serves. Availability of readily applicable information on recycling, reuse, and recovery opportunities, on substitute materials, on conservation practices, etc., is one of the most significant impediments to change. Using institutional theory, Chen, Boudreau, & Watson (2008) argues that information systems can help organizations develop ecological sustainability. They call for collaborative initiatives from practitioners and researchers to design and build a more eco-efficient data center that withholds geographically disseminated data to a centralized location.

The Research Gap

The Côté & Smolenaars (1997) article and its findings referenced earlier provides a nice segue into the research milieu that we would like to open up. It is clear from the reviewed literature that if there is a focus in IS related research on sustainability, it is from the perspective of reducing the carbon foot print in the use and deployment of energy, economical use of resources, management of toxic waste products related to computing, etc. It is not from the point of view of assisting organizations to be more sustainable in the sense of flourishing in their line of business by using information to enhance their product development, production and operations, supply chains, and marketing efforts to be at once more efficient and 3BL friendly, thus contributing to business sustainability. For example, in the initial stages of a product's development, if the developers are made aware of the alternatives for materials proposed to be used and their sustainability characteristics, both ecological and supply chain related, informed decisions can be made that leverage this information to develop a sustainable and competitive posture in the firm's market segment. This would satisfy the 3BL goals of the organization, while contributing to the sustainability of the firm as well.

However, the data and information that are required to fuel such sustainability does not reside within any single organization, but is scattered in many places including the firms themselves, industry chambers of commerce, governmental sources, practitioner publications, trade journals, and research literature. Further, the firms are unaware of what they would need to achieve long term sustainability, because their focus is merely on satisfying the 3BL goals in the short term, while deriving some beneficial public relations exposure. In addition, the firms would not have the infrastructure to identify, acquire, deploy, and use the right information at the right time in the appropriate situation to derive long term sustainability while also achieving their 3BL goals. This suggests the need for the existence of an entity or enterprise, outside of the information using firms, that is the gatherer, distributor, and repository of information needed in the industry setting of the firms needing that information.

A number of issues arise, immediately, in pursuing this avenue of opportunity. What is the incentive for the information enterprise that collects and maintains the data aforementioned? Where does the data come from? How often is the data to be collected? How much historical data is to be maintained? What information will be needed from the industry participants, possibly eventual beneficiaries, and why should they be willing to part with that information? What granularity of information would be required? What, if any, pricing power would the information enterprise have to sustain the enterprise and profit from it? What kind of infrastructure would be needed by this enterprise– hardware, software, personnel, data communications and security facilities, procedures etc.? What are the linkages that would be required connecting this enterprise to other entities to maintain the currency of data, the relevancy of data, and the collection of trending information? Where would the financing come from for launching such an enterprise – from the potential beneficiary firms? Or venture capitalists? Or a combination? How reliable would the repository information be? How to validate the information?

Having access to the information, likely to be provided by the information enterprise (IE) is one thing; being able to effectively deploy it for sustainability is an entirely different proposition. From the firms' perspective, the availability of the information from the IE becomes a great leveler, in terms of making the same information available to all participants in that industry segment, making for an efficient marketplace to borrow the term from Finance. The firm has to able to identify the "right" information for its purposes and deploy it effectively to achieve the dual goals of sustainability and market competiveness. On the other end, the IE has to able to validate and authenticate the information that is shared by the participating firm. Given that information systems organizations within businesses are all but defunct, this determination of what to do and how to get it done is not likely to be easy, without due deliberation and careful thought. The development of a strategy to identify what to share with the IE, and what information to receive from the

IE becomes an immediate first step. The strategy development would have to be preceded by a careful look at the product (service) lines and production (service) activities, associated supply chains, organizational culture, skill sets of personnel, the skill gap to be filled for appropriately deploying the information received from the IE, integration of firm specific information with the information from IE for achieving competitive advantage.

The schematic below lays out our vision in terms of how the pieces fit. This is an eclectic view that would require further refinement as specific business environments and their sustainability needs are addressed.

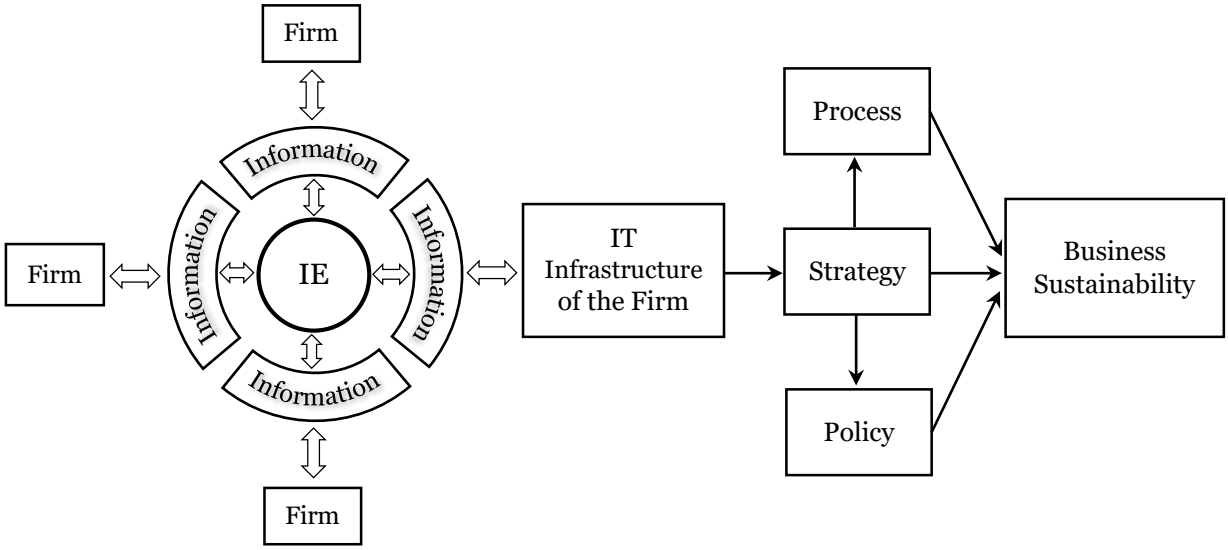

Figure 1. Framework for IS supported Sustainability of the Firm Using Information Enterprise

A Research Framework for IS supported Sustainability of the Firm

Investigative research needs to be conducted into the following issues to resolve the questions raised earlier. We begin by enumerating the research questions first from the IE perspective and then from the firms' perspective. There are obviously overlapping areas, such as receipt of information from firms by the IE, that we will include in the IE enumeration with due deference to the attendant firm issues.

A. The needs of the Information Enterprise

- Receptivity of the business/industry environment to the establishment of the repository of sustainability oriented information
- Identification and pipelining of the information into the repository and the maintenance of the currency of information.
- Validation of the received information.
- Identification of the granularity of the information for inclusion in the repository, in the context of the expected finer granularity being available at the firm level as part of the firm's competitive advantage.
- What information will be needed from the participating firms?
- How should the IE repository be funded?

- How will the information be distributed? That is, should the IE's interface with the participant firms be on standardized platform? Proprietary platform? Secure platform? Public communication system vs private communication system.
- What is a reasonable pricing rubric?
- Are there legal impediments to the acquisition and dissemination of the information?
- The computing infrastructure needs of the IE – including hardware, software, personnel, data communications facilities, policies, and procedures.
- Technological competence and training needs of personnel.

B. The needs of the participant Firm

- Will participation in the information exchange be a positive or a negative for the firm?
- What information and at what granularity should the firm be willing to provide information to the exchange?
- Development of a strategy for benefiting from the IE sourced information.
- Who will identify what information is needed, including that which is needed for process development or improvement and product development or improvement?
- What information processing infrastructure will the firm need to properly use the received information?
- Development of the infrastructure needed to appropriately deploy and use the information for sustainability.
- The alignment of the supply chains associated with the firm in the use and deployment of the IE information.
- The firm's organizational culture and if that needs to be modified to benefit from the IE information.
- Development of personnel skill sets and exposure to new information technologies.
- Validation of IE information for appropriate firm use
- Measurement metrics for the contribution of IE sourced information to improving the sustainability of the firm and associated achievement of 3BL goals.

Research Opportunities

- Exploratory studies need to be done to identify business environments that can benefit from the aforementioned information based firm centric sustainability vision, as a first priority. Based on the findings of these exploratory studies, additional more focused studies would have to be done to better understand the problems and develop concepts and solutions.
- Develop case studies, pilot studies, and longitudinal studies to flesh out and elaborate on the identified issues and concerns. This may result in unearthing hidden issues that may require further investigation.
- Develop a comprehensive model for seeding the IE information, selecting the IE information to import, and the effective deployment and use of that information, to inform and/or impact:
    - Strategy formulation
    - strategy implementation
    - Identification of IE information that is needed
    - Infrastructure needed to effectively deploy the IE information
    - Resource barriers that will be lost and those that get erected to derive competitive edge in adopting and deploying IE information.

More pointedly:

- Specifically, develop case studies/field studies to identify infrastructure capabilities and limitations in both IE and firm contexts
- Develop understanding of the receptivity of the business environment (may need different studies for different environments) to the launching of an IE entity and the willingness of firms in that environment to participate in the information exchange.

- Develop an understanding of the existing sustainability practices and the extent of modifications and the associated challenges in modifying the firm's business practices to benefit from the IE information in achieving firm sustainability.
- Organizational learning issues associated with readiness for accommodating and benefiting from IE information.

Conclusion

Strategic decisions for business sustainability, while also addressing all the aspects of 3BL, cannot be made with information from a single entity or even a supply chain. They require information from a network of firms and business processes associated with this network of firms. This research has recognized the need for an entity or enterprise, designated the Information Enterprise (IE) that is the repository and sole distributor of relevant information that participant firms will need to deploy in their business settings for achieving sustainability without sacrificing their 3BL goals. Further we have identified the issues that need to be addressed by the IE in developing and maintaining this repository. In the wake of it, we have identified issues associated with the firms availing themselves of the repository information, focusing on what it would take for the firms to effectively use and deploy the information that they acquire from the IE. We have documented the areas in need of investigation by researchers, in the context of the identified issues – both from the IE perspective and the participant firm perspective. We conclude with suggestions for methodologies that could be used to conduct these investigations and also suggest a prioritization of efforts needed to effectively design the information exchange and for the deployment and application of this information by the benefitting firms.

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